Early Journal Content on JSTOR, Free to Anyone in the World

This article is one of nearly 500,000 scholarly works digitized and made freely available to everyone in the world by JSTOR.

Known as the Early Journal Content, this set of works include research articles, news, letters, and other writings published in more than 200 of the oldest leading academic journals. The works date from the mid-seventeenth to the early twentieth centuries.

We encourage people to read and share the Early Journal Content openly and to tell others that this resource exists. People may post this content online or redistribute in any way for non-commercial purposes.

Read more about Early Journal Content at http://about.jstor.org/participate-jstor/individuals/early-journal-content.

JSTOR is a digital library of academic journals, books, and primary source objects. JSTOR helps people discover, use, and build upon a wide range of content through a powerful research and teaching platform, and preserves this content for future generations. JSTOR is part of ITHAKA, a not-for-profit organization that also includes Ithaka S+R and Portico. For more information about JSTOR, please contact support@jstor.org.

that an enormous saving might be effected in the present consumption of pipe water; so that the spring-well water of the several St. Patrick's well districts, as well as that of other ancient well districts in Dublin, might become a great supply of water in aid of that now derived from the Dodder and the Grand and Royal Canals; and the present demand for good drinking water, and water for other purposes, in a great measure, locally, if not generally, met, simply and economically, by the public utilization of the spring-well water of Dublin.

Lord Talbot de Malahide exhibited a peculiarly shaped stone hammer, found at Glencoy, county of Antrim.

Mr. W. R. Wilde exhibited two drawings, representing celts with handles, taken from sculptures on stones near Vannes, Britany.

MONDAY, FEBRUARY 13, 1860.

JAMES HENTHORN TODD, D. D., President, in the Chair.

JOHN KELLS INGRAM, LL. D., was elected Secretary to the Council, in the room of the Rev. J. H. Jellett, resigned; and James Haughton, Esq., was elected a Member of the Academy.

DR. ROBERT M'DONNELL read a paper—

ON THE FORMATION OF SUGAR AND AMYLOID SUBSTANCE IN THE ANIMAL ECONOMY.

AT the meeting of the Academie des Sciences held on the 23rd of March, 1857, Professor Bernard read a memoir upon the physiological mechanism of the formation of sugar in the liver. In this communication he announced the discovery of a particular substance formed by the liver, readily changed into sugar in the presence of certain ferments, and hence named by him "glucogenic matter." He asserted that in animals fed exclusively on meat, the liver, to the exclusion of all other organs in the body, possessed the power of making this substance, a non-azotised compound, analogous to starch, and, like it, convertible into sugar.

Hensen, somewhat prior to Bernard, and quite independently of him, had isolated this substance, the discovery of which, without doubt, constitutes one of the most important facts of animal physiology. Its discovery excited a very lively interest in the scientific world; and physiologists have since very warmly discussed the following questions regarding it:—

1st. Has the liver the power of forming it from azotized compounds?

2nd. Is the liver endowed with the function of converting it into sugar during life and health?

3rd. Has the liver the exclusive privilege of forming it, or is it met with in other tissues and organs?

These questions are among the most interesting and delicate of physiology, and certainly do not bear to be treated of dogmatically.

In the following communication the term "amyloid substance" shall, for reasons elsewhere indicated, be substituted for "glucogenic substance;" and it may be well to state that this is a generic term applied to animal substances having special characters, apparently forming a link between the immediate (azotized) principles of animal structures, and the (non-azotized) vegetable formations, in some varieties presenting the characteristics of starch or dextrine of vegetable origin, yet in others giving unquestionable indications of the presence of nitrogen.

The species of amyloid substance spoken of in this memoir belongs to the former group, and, being free from the intimate admixture of azotized matters, is consequently distinct from the amyloid substance of Virchow, which, although in histological characters analogous to cellulose and starch, yet, as met with in the prostate gland, the spleen, choroid plexus, &c., has not yet been shown to be convertible into sugar capable of fermentation.

The first may be indicated as *the amyloid substance of Bernard,* or (being evidently nearer to the vegetable kingdom), *of first species;* the latter as *amyloid substance of Virchow*, or *of the second species.*

The amyloid substance of Bernard, or of the first species, is a ternary compound isomeric with dried grape sugar. It is a neutral, whitish, inodorous, insipid matter, soluble in water, insoluble in alcohol and strong acetic acid.

In the presence of saliva and other animal ferments it is converted into sugar, which ferments on the addition of yeast, and reduces the cupro-potassic solution; iodine in contact with it produces a peculiar brown coloration, more or less intense, disappearing on the application of heat, and reappearing when the fluid cools below 80°; like dextrine, it causes the plane of polarization to deviate to the right.

It was first obtained by Bernard by treating the boilings of the liver with four or five times its volume of absolute alcohol, and subsequently freeing the precipitate thus formed from azotized matters by boiling it for some time in a concentrated solution of caustic potash. This method is objectionable. The acetic acid process, although not economical, is preferable, and, indeed, is invaluable as a test for the presence of the substance in question in the various tissues of the organism.

The organ or tissue to be examined is boiled in a small quantity of distilled water; the whole is then bruised in a mortar with animal charcoal, thrown on a filter, and some drops allowed to fall into glacial acetic acid. If amyloid substance of the first species is present, it forms a more or less abundant white, flaky precipitate.

Gelatine and casein are not arrested upon the filter by the animal charcoal, but the first is soluble in acetic acid, and the latter, although at first precipitated, is at once re-dissolved by the glacial acid. These substances, therefore, do not interfere where acetic acid is used, but the contrary is the case with alcohol.

If the tissue, while still raw, be pounded in a mortar with animal charcoal, the albuminoid materials are more completely retained by it upon the filter; but one never can feel satisfied that absolutely no gelatine passes through when fibrous and muscular structures are being examined.

For this reason the acetic acid process seems less subject to error than any of the modifications of the methods in which alcohol and potash are used, and, accordingly, in the following experiments the former has been the process adopted:—

1st. Has the liver the power of forming amyloid substance of the first species from azotized materials? This question may probably be answered in the affirmative. The connexion between this substance and sugar is so close that the question may be made more general. Are saccharine and amylaceous matters formed in the animal economy from azotized matters? Chemists have obtained of late years a great number of results which tend to show that ternary compounds may result from azotized elements. Lehman has obtained it from hæmatine. Dogs fed for many days on meat exclusively are found to have amyloid substance in the liver, and, on being killed, saccharine matter is found sufficiently abundant in the blood and tissue of that organ. Bitches fed exclusively on meat for days continue to form milk containing sugar. I have lately verified the same fact in cats. It is argued, however, that, nevertheless, the amylaceous and saccharine matter enters from without, for that the herbivora find the amylaceous principle in vegetables; that it accumulates in their tissues, and through this channel enters the organisms of the carnivora; that, in short, while the bitches and cats are secreting milk, they are obtaining starchy materials from whence to elaborate the sugar of it from the meat on which they live.

That this is not the case, may be argued from the following experiments:—

First experiment:—Six samples of mutton were obtained, as fresh as possible, and treated as follows: two ounces of each chopped up and boiled in one ounce of distilled water for half an hour; the whole bruised in a mortar, and made into paste with animal charcoal; the paste, placed in a filter, was washed with boiling distilled water, merely enough to allow a small quantity to pass through, which was let drop into a test-tube containing glacial acetic acid. In no one of the six instances did any precipitate of amyloid substance result.

Second experiment:—Six samples of beef, obtained quite fresh, were similarly treated. In no one instance did any precipitate of amyloid substance result.

Third experiment:—The flesh of two rabbits was thus treated: the hind quarters chopped up; boiled for some hours in as much water as was sufficient to bathe the whole; the highly gelatinous broth strained off and evaporated to a small bulk, mixed with animal charcoal, placed in a filter, and washed with boiling distilled water, so that a few drops were yielded, which were allowed to drop into glacial acetic acid. A small amount of a white substance was precipitated, which did not give with iodine the characteristic reaction. The fluid obtained from the filter was, of course, highly gelatinous, and gave an abundant precipitate when dropped into absolute alcohol.

Fourth experiment:—Mutton, beef, veal, and rabbit flesh was treated thus: of each two ounces were pounded to pulp in a mortar, thoroughly mixed with one ounce of distilled water; the expressed fluid boiled, filtered, and placed in tubes over mercury, with yeast; equal portions of the same meats, when reduced to pulp, were mixed with saliva, and for some time kept at a temperature between 100° and 120°; subsequently, one ounce of distilled water was added to each of the expressed fluids, boiled, filtered, and placed in tubes with yeast, as the rest. In all a little more carbonic acid gas was formed than in the tube (always used as a corrector), containing an equal quantity of yeast, placed in distilled water. The meat, mixed with saliva, did not give more than that to which no saliva had been added, as it should have done did the meat contain amyloid substance convertible into sugar by contact with saliva.

Is the liver endowed with the power of converting its amyloid substance into sugar during life and health? This question is answered differently by some of the most eminent living physiologists. In taking one side, therefore, I do so with the greatest diffidence, feeling strongly the great delicacy of the question. It seems to me that there is, on the whole, evidence that the amyloid substance met with in the liver is, as it were, on its way upwards towards the more exalted or complex immediate animal principles, and that its conversion into sugar is not its normal destination; that the process of healthy assimilation tends, if the expression may be used, to promote it from the rank of ternary to that of quaternary compounds; and that its transition into sugar is, therefore, a deviation from this progressive course—a dissimilative instead of an assimilative process.

No one now doubts that if an animal, which has been fed for some time exclusively on meat, is killed by pithing, that, although no sugar exists in the portal blood, it is found in the hepatic; but it is doubted by some whether this glucogenesis is a perfectly normal process going on during life. In making experiments on the tissue of the liver immediately after death, no matter what rapidity, precision, and care are exercised, it must be confessed that results are met with which seem contradictory. However, the object being to ascertain the condition of the hepatic blood during life, I have had recourse to catheterism of the right side of the heart—an operation which, in the hands of others, has given results corresponding with those to which I now allude.

1st. In twelve experiments made on dogs, for some weeks before fed exclusively on meat, traces of sugar were found in the blood of the right side of the heart in five; there was no sugar discoverable in the blood of the remaining seven.

2nd. In four rabbits fed on boiled eggs, meat, and butter, for some days, no sugar was detected in the blood drawn from the right side of the heart.

3rd. In three dogs fed on mixed diet, and three rabbits fed on carrots, potatoes, &c., sugar was found in the blood of the right side of the heart, and in equal quantity in the blood taken from the carotid.

4th. In three rabbits fed on vegetables, sugar was found in the blood of the right side of the heart, drawn during life; but double, and in one instance more than treble the amount, was found in the blood sucked from the same locality after the animals were killed (one by pithing, two by hydrocyanic acid).

Hence one seems in some degree justified in concluding that in vegetable-eating animals the blood is normally saccharine, but that the liver does not appear during life to form and pour out into the blood of the hepatic vessels sugar specially derived from the transformation of the amyloid substance into that material.

The fact that fibrine is deficient in the blood leaving the liver, does not militate against the view that the amyloid substance is a matter in progress of assimilation towards becoming an azotized material; it may lead to the supposition that the fibrine is destroyed in the liver by parting with some of its nitrogen to combine with the ternary compound.

Lastly, has the liver the special privilege of making, to the exclusion of other organs and tissues, the amyloid substance of the first species?

It is now satisfactorily known that it has not: and the facts recently brought forward upon this point are, perhaps, the most conclusive evidence which can be offered that this amyloid substance is related to the tissues in which it is found rather as a reparative material, or protoplasma, than as one formed for special transformation into sugar.

Amyloid substance of the second species has been found in various forms, widely diffused throughout the animal organism, either as normal or morbific deposits; in the form of tunicine, identical in composition with cellulose uncombined with azote; as chitine consisting of cellulose in union with a proteic compound, it has been caused to ferment by Berthelot; while, as met with in the prostate, spleen, choroid plexus, and, in what is known as amyloid degeneration of many organs, it has as yet resisted all attempts to change it into fermentescible sugar. This, probably, is on account of its intimate admixture or chemical union with azote, and the analogy, therefore, comes to be striking between this matter and the azotized fats of nervous centres (cerebrine).

It is, however, the existence of the first species of amyloid substance in other organs and tissues than the liver to which the present question refers, and with regard to which the following facts are before us:—

1st. Amyloid substance (*of the first species*) of Bernard, is abundant in the liver: much more so in animals fed on saccharine and amylaceous food than in those fed on meat—diminishing rapidly in quantity in the livers of animals not fed at all for some days, except in the case of hybernating animals, when it is found in quantity many days after the animal is asleep.

2nd. It is found in the placenta, most plentiful, about the third and fourth months of utero-gestation.

3rd. It exists in the lung and muscles of the fœtus, as well as in the epithelial cells of the skin, respiratory and digestive organs.

4th. It is beautifully seen in the cells of the formative material of the soft horn of the foot of the fœtal calf.

(5th. It is met with in the muscular flesh of healthy horses?)

6th. In the cartilage of the embryo of the chick.

7th. In the muscles and lungs of hybernating animals.

8th. In muscles paralyzed in consequence of section of their motor nerves.

9th. Although easily separable from the liver tissue by boiling water, it does not in its natural (raw) state produce with iodine its characteristic reaction.

This last is one of the fundamental points which leads to the notion that in this organ it gets into union, more or less intimate, with some azotized compound, and passes from the order of starch to that of proteic compounds in its normal assimilative progress.

That the retrograde process, destructive assimilation, or disassimilation of the muscles, &c., is, under certain circumstances, accompanied by the production of *sugar, lactic acid,* and *inosite,* all non-nitrogenous, is corroborative of the same view.

Rev. Charles Graves, D. D., read a paper "On a hitherto undescribed class of Monumental Stones found in Ireland," supposed by him to be maps; and in the course of the paper he established a law of alignment of the raths, duns, and lisses, which are found to be, in general, three by three in straight lines in all parts of Ireland.

MONDAY, FEBRUARY 27, 1860.

James Henthorn Todd, D. D., President, in the Chair.

It was resolved, on the recommendation of the Council, that the Committee of Publication be restored, pursuant to Chapter IX. of the By-Laws, some time repealed; that the Committee of Publication shall meet the day following each meeting of the Academy; and that it shall be part of its duty to decide as to whether the papers read to the Academy shall appear in the Proceedings or in the Transactions.

The following is chapter ix. of the By-Laws, now re-enacted:—

"I. That a Committee be formed, corresponding to the Committee of Publication of the Royal Society.

"II. That the Committee shall consist of seven members—three from the Committee of Science, and two from each of the other Committees.

"III. That it shall be the duty of this Committee—

"1. To report to Council on all papers offered for publication in the Transactions.

"2. To superintend the final correction of the press, and to see that the printing and engraving are executed in a manner creditable to the Academy.

"3. To arrange all details connected with the printing and publication of the Transactions of the Academy and the Proceedings.